PTO Form 1960 (Rev 9/2007)
OMB No. 0651-0050 (Exp. 07/31/2017)

Request for Reconsideration after Final Action

The table below presents the data as entered.

Input Field	Entered
SERIAL NUMBER	86311033
LAW OFFICE ASSIGNED	LAW OFFICE 116
MARK SECTION (no change)	
ARGUMENT(S)	
See evidence section for arguments in favor if registration.	
EVIDENCE SECTION	
EVIDENCE FILE NAME(S)	
ORIGINAL PDF FILE	evi_66185170138-20150514122739010586_._Final-OAR_Richter.pdf
CONVERTED PDF FILE(S) (5 pages)	\\TICRS\EXPORT16\IMAGEOUT16\863\110\86311033\xml7\RFR0002.JPG
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CONVERTED PDF FILE(S) (13 pages)	\\TICRS\EXPORT16\IMAGEOUT16\863\110\86311033\xml7\RFR0007.JPG
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ORIGINAL PDF FILE	evi_66185170138-20150514122739010586_._ExB-Richter_-_Wikipedia-gen.pdf
CONVERTED PDF FILE(S) (1 page)	\\TICRS\EXPORT16\IMAGEOUT16\863\110\86311033\xml7\RFR0020.JPG
DESCRIPTION OF EVIDENCE FILE	arguments in favor of registration and evidence indicating the purchasing public's understanding of the mark
SIGNATURE SECTION	
RESPONSE SIGNATURE	/clm/
SIGNATORY'S NAME	Candace L. Moon
SIGNATORY'S POSITION	Attorney of Record, CA bar member
SIGNATORY'S PHONE NUMBER	866-290-5553
DATE SIGNED	05/15/2015
AUTHORIZED SIGNATORY	YES
CONCURRENT APPEAL NOTICE FILED	YES
FILING INFORMATION SECTION	
SUBMIT DATE	Fri May 15 15:21:01 EDT 2015
TEAS STAMP	USPTO/RFR-66.185.170.138-20150515152101787502-86311033-53021862458cbdbf313a4baa2a6d286569d96522498887948b9b017732da14ba5-N/A-N/A-20150515151951992444

PTO Form 1960 (Rev 9/2007)
OMB No. 0651-0050 (Exp. 07/31/2017)

Request for Reconsideration after Final Action

To the Commissioner for Trademarks:

Application serial no. **86311033** has been amended as follows:

ARGUMENT(S)
In response to the substantive refusal(s), please note the following:

See evidence section for arguments in favor if registration.

EVIDENCE
Evidence in the nature of arguments in favor of registration and evidence indicating the purchasing public's understanding of the mark has been attached.
Original PDF file:
evi_66185170138-20150514122739010586_._Final-OAR_Richter.pdf
Converted PDF file(s) (5 pages)
Evidence-1
Evidence-2
Evidence-3
Evidence-4
Evidence-5
Original PDF file:
evi_66185170138-20150514122739010586_._ExA-Richter_magnitude_scale_-_Wikipedia.pdf
Converted PDF file(s) (13 pages)
Evidence-1
Evidence-2
Evidence-3
Evidence-4
Evidence-5
Evidence-6
Evidence-7
Evidence-8
Evidence-9
Evidence-10
Evidence-11
Evidence-12
Evidence-13
Original PDF file:
evi_66185170138-20150514122739010586_._ExB-Richter_-_Wikipedia-gen.pdf
Converted PDF file(s) (1 page)
Evidence-1

SIGNATURE(S)
Request for Reconsideration Signature
Signature: /clm/ Date: 05/15/2015
Signatory's Name: Candace L. Moon

Signatory's Position: Attorney of Record, CA bar member

Signatory's Phone Number: 866-290-5553

The signatory has confirmed that he/she is an attorney who is a member in good standing of the bar of the highest court of a U.S. state, which includes the District of Columbia, Puerto Rico, and other federal territories and possessions; and he/she is currently the applicant's attorney or an associate thereof; and to the best of his/her knowledge, if prior to his/her appointment another U.S. attorney or a Canadian attorney/agent not currently associated with his/her company/firm previously represented the applicant in this matter: (1) the applicant has filed or is concurrently filing a signed revocation of or substitute power of attorney with the USPTO; (2) the USPTO has granted the request of the prior representative to withdraw; (3) the applicant has filed a power of attorney appointing him/her in this matter; or (4) the applicant's appointed U.S. attorney or Canadian attorney/agent has filed a power of attorney appointing him/her as an associate attorney in this matter.

The applicant is filing a Notice of Appeal in conjunction with this Request for Reconsideration.

Serial Number: 86311033
Internet Transmission Date: Fri May 15 15:21:01 EDT 2015
TEAS Stamp: USPTO/RFR-66.185.170.138-201505151521017
87502-86311033-53021862458cbdbf313a4baa2
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On November 18, 2014, the Trademark Examining Attorney issued an office action refusing, pursuant to Section 2(e)(4), the applied-for mark RICHTER for beer as being primarily merely a surname. Applicant respectfully requests that the Examining Attorney reconsider and Applicant notes that it is concurrently filing a notice of appeal.

As to the Section 2(e)(4) refusal, Applicant's mark RICHTER will not be primarily recognized as merely a surname to the purchasing public. Determination of whether a mark is primarily merely a surname under Section 2(e)(4) is made on a case-by-case basis and the factors set forth in *In re Benthin Management GmBH*, 37 USPQ2d 1332, 1334 (TTAB 1995) aid in this determination. Although, depending on the evidence of record, not all of the *Benthin* factors are necessarily relevant or of equal weight in a given case, here the following factors are the most relevant: degree of the surname's "rareness," whether the mark has any recognized meaning other than as a surname, and whether the mark has the "look and sound" of a surname. *Id.* Indeed, although the Examining Attorney considered several of the *Benthin* factors, the mark warrants registration.

The Lanham Act bars federal registration without secondary meaning under Section 2(e)(4) only to marks that are "primarily merely a surname." In *Benthin*, the Board identified five factors to consider in determining whether a mark is primarily merely a surname: (1) The degree of the surname's "rareness"; (2) Whether anyone connected with the applicant has the involved term as a surname; (3) Whether the mark has any recognized meaning other than as a surname; (4) Whether the mark has the "look and sound" of a surname; and (5) whether the manner in which the mark is displayed might negate any surname significance. *In re Benthin Management GmbH,* 37 USPQ2d

1332, 1334 (TTAB 1995). On the issue of whether a mark is primarily merely a surname under Section 2(e)(4), any doubts must be resolved in favor of the applicant. *In re Isabella Fiore, LLC*, 75 U.S.P.Q.2d 1564, 2005 WL 1787224 (T.T.A.B. 2005) ("Our case law holds that if we have doubts about whether the term is a surname, we resolve them in favor of the applicant and for publication of the mark.").

<u>THE MARK IS REGISTRABLE BECAUSE RICHTER CONSTITUTES A RARE SURNAME.</u>

Applicant respectfully maintains that "Richter" is a rare surname. The Examining Attorney notes that "Richter" appears 100 times in a nationwide telephone directory. The Examining also correctly notes that there is no minimum number of telephone directory listings needed to prove that a mark is primarily merely a surname. Similarly, there is no set benchmark to determine rareness. As noted earlier, in *In re Lorch Schweißtechnik GmbH*, Serial No. 85037839 (November 29, 2012) (not precedential) the Trademark Trial and Appeal Board found that 470 listings for the name "Lorch" made for an "extremely rare surname." This case is especially like *In re Okamoto Corp*. though. There, the examining attorney submitted 739 Lexis listings for the surname "Okamoto," 33 Internet excerpts referencing persons with that surname, and also pointed to the fact that the applicant's president is named Mr. Tetsuji Okamoto. *In re Okamoto Corp.*, Serial No. 85739429 (February 6, 2015) [not precedential]. The Trademark Trial and Appeal Board reversed the 2(e)(4) rejection however.

Reasoning that the test for determining whether a mark is primarily merely a surname is the *primary significance of the mark as a whole to the purchasing public*, the Board held that evidence of 738 entries was not substantial evidence that the term

"Okamoto" was a common surname. In fact, the 738 entries (which outnumber the evidence submitted in the present case) "supported the finding that the surname 'Okamoto' is a fairly rare surname." *In re Okamoto Corp.*, Serial No. 85739429 (February 6, 2015); see also *In re United Distillers plc.*, 56 USPQ2d 1220, 21 (TTAB 2000) ("Hackler" held to be a rare surname despite 1295 listings in phone directories). Furthermore, despite evidence of 33 articles referencing individuals with the surname "Okamoto," the Board noted that, when focusing on the all-important consumer impression of the mark, "taken as a whole, the 33 excerpts d[id] not reflect the type of uses that would outweigh the relative rareness of this surname." *In re Okamoto Corp.*, Serial No. 85739429 (February 6, 2015). The same reasoning applies here where the evidence of articles with famous individuals bearing the surname "Richter" are not necessarily of the type that outweigh its relative rareness. Lastly, the Board found that Okamoto was not primarily merely a surname, despite the fact that the president of the applicant (like here) bore the mark as a surname and no alternative recognized meanings were found for the mark (which in fact are present here, as noted below). Taken together then, RICHTER has all of the factors that weighed in OKAMOTO's favor in addition to several more. Hence, RICHTER is not primarily merely a surname and the mark warrants registration.

THE MARK IS REGISTRABLE BECAUSE THE MARK IS NOT* PRIMARILY MERELY *A SURNAME GIVEN A VARIETY OF ALTERNATIVE RECOGNIZED MEANINGS.

Applicant by no means denies that RICHTER is a surname, however, Applicant maintains that RICHTER is not ***primarily*** a surname, nor is it ***merely*** a surname as it has other well-recognized meaning that outweigh any significance it may have as a surname given its relative rareness. In *Ex Parte Omaha Cold Storage Co.*, 111 U.S.P.Q. 189, 1956 WL 7069 (Comm'r Pat. & Trademarks 1956), the mark DOUGLAS was held to be not primarily merely a surname because, in addition to being a surname, it was also the name of a Scottish clan, the name for a number of cities and counties, the name of a street in many localities, a species of fir tree, and a species of squirrel. In *Ex Parte Gemex Company*, 111 U.S.P.Q. 443, 1956 WL 7120 (Comm'r Pat. & Trademarks 1956), the mark's use as a geographical name, the national capital of New Zealand, the name of a number of towns in the United States, a baptismal name, and the name of a UK dukedom outweighed its surname significance.

Here too there are alternative meanings that the purchasing public would likely recognize when faced with the RICHTER mark. As noted earlier, the Richter Magnitude Scale is a very well known reference that outweighs any surname significance. While the Examining Attorney points out that the Richter Magnitude Scale in fact takes its name from an individual with the surname Richter, there is no indication that the purchasing public is likely to be aware of that fact or has assigned such significance to it. The primary definition and description of the Richter Magnitude Scale in Wikipedia notably lacks any reference to the developer sharing the name and in fact only references him in a subheading describing the development of the measurement system. Exhibit A.

Additionally, when searching the term "Richter" in Wikipedia generally the results pages bears no less than eleven possible articles bearing the title. A few, like in Okamoto, reference individuals with the surname RICHTER but the plethora of alternative recognized meanings, including a city in Kansas (like in *Omaha Cold Storage Co* and *Gemex Company)*, an electro-rock band from Buenos Aires, Argentina, a tuning scale for harmonicas developed in 1825, a pharmaceutical company, a German toy company, a song by The Ziggens (a California-based band), and a disease involving complication of blood-related neoplasms, outweighs the surname significance when combined with the rareness of the name generally. Exhibit B. Thus, by no means is the *primary* significance of the RICHTER mark *merely* that of a surname. Therefore, the third *Benthin* factor regarding whether a mark has any recognized meaning other than as a surname favors registration of Applicant's RICHTER mark. *In re Benthin Management GmbH,* 37 U.S.P.Q.2d 1332, 1334 (TTAB 1995).

For the foregoing reasons – notably, that the mark is rarely used as a surname and has other well-known and significant meanings that consumers are likely to recognize– the mark is registrable and we respectfully request that the applicant's RICHTER mark proceed to publication.

Richter magnitude scale

From Wikipedia, the free encyclopedia

The **Richter magnitude scale** (also **Richter scale**) assigns a magnitude number to quantify the energy released by an earthquake. The Richter scale is a base-10 logarithmic scale, which defines magnitude as the logarithm of the ratio of the amplitude of the seismic waves to an arbitrary, minor amplitude.

As measured with a seismometer, an earthquake that registers 5.0 on the Richter scale has a shaking amplitude 10 times that of an earthquake that registered 4.0, and thus corresponds to a release of energy 31.6 times that released by the lesser earthquake.[1]

Developed in the 1930s, it was succeeded in the 1970s by the Moment Magnitude Scale (MMS) which is now the scale used to estimate magnitudes for all modern large earthquakes by the United States Geological Survey.[2] However, earthquake magnitudes are still sometimes incorrectly reported as "an earthquake of XX on the Richter scale", when the correct terminology using the MMS is "a magnitude XX earthquake".

Contents

Development

In 1935, the seismologists Charles Francis Richter and Beno Gutenberg, of the California Institute of Technology, developed the (future) Richter magnitude scale, specifically for measuring earthquakes in a given area of study in California, as recorded and measured with the Wood-Anderson torsion seismograph. Originally, Richter reported mathematical values to the nearest quarter of a unit, but the values later were reported with one decimal place; the local magnitude scale compared the magnitudes of different earthquakes.[1] Richter derived his earthquake-magnitude scale from the apparent magnitude scale used to measure the brightness of stars.[3]

Richter established a magnitude 0 event to be an earthquake that would show a maximum, combined horizontal displacement of 1.0 μm (0.00004 in.) on a seismogram recorded with a Wood-Anderson torsion seismograph 100 km (62 mi.) from the earthquake epicenter. That fixed measure was chosen to avoid negative values for magnitude, given that the slightest earthquakes that could be recorded and located at the time were around magnitude 3.0. However, the Richter magnitude scale itself has no lower limit, and contemporary seismometers can register, record, and measure earthquakes with negative magnitudes.

M_L (local magnitude) was not designed to be applied to data with distances to the hypocenter of the earthquake greater than 600 km (373 mi.).[4] For national and local seismological observatories the standard magnitude scale is today still M_L. This scale saturates at around $M_L = 7$,[5] because the high frequency waves recorded locally have wavelengths shorter than the rupture lengths of large earthquakes.

Charles Francis Richter, c. 1970

Later, to express the size of earthquakes around the planet, Gutenberg and Richter developed a surface wave magnitude scale (M_s) and a body wave magnitude scale (M_b).[6] These are types of waves that are recorded at teleseismic distances. The two scales were adjusted such that they were consistent with the M_L scale. That adjustment succeeded better with the M_s scale than with the M_b scale. Each scale saturates when the earthquake is greater than magnitude 8.0, and, therefore, the moment magnitude scale (M_w) was invented.

The older magnitude-scales were superseded by methods for calculating the seismic moment, from which derived the moment magnitude scale. About the origins of the Richter magnitude scale, C.F. Richter said:

> I found a [1928] paper by Professor K. Wadati of Japan in which he compared large earthquakes by plotting the maximum ground motion against [the] distance to the epicenter. I tried a similar procedure for our stations, but the range between the largest and smallest magnitudes seemed unmanageably large. Dr. Beno Gutenberg then made the natural suggestion to plot the amplitudes logarithmically. I was lucky, because logarithmic plots are a device of the devil.
>
> — Charles Richter Interview, abridged from the *Earthquake Information Bulletin*, Vol. 12, No. 1, January-February, 1980. (http://earthquake.usgs.gov/learn/topics/people/int_richter.php)

Details

The Richter scale was defined in 1935 for particular circumstances and instruments; the particular circumstances refer to it being defined for Southern California and "implicitly incorporates the attenuative properties of Southern California crust and mantle,"[7] and the particular instrument used would became saturated by strong earthquakes and unable to record high values. The scale was replaced by the moment magnitude scale (MMS); for earthquakes adequately measured by the Richter scale, numerical values are approximately the same. Although values measured for earthquakes now are actually M_w (MMS), they are frequently reported as Richter values, even for earthquakes of magnitude over 8, where the Richter scale becomes meaningless. Anything above 5 is classified as a risk by the USGS.

The Richter and MMS scales measure the energy released by an earthquake; another scale, the Mercalli intensity scale, classifies earthquakes by their *effects*, from detectable by instruments but not noticeable to catastrophic. The energy and effects are not necessarily strongly correlated; a shallow earthquake in a populated area with soil of certain types can be far more intense than a much more energetic deep earthquake in an isolated area.

There are several scales which have historically been described as the "Richter scale", especially the *local magnitude* M_L and the surface wave M_s scale. In addition, the *body wave magnitude*, m_b, and the *moment magnitude*, M_w, abbreviated MMS, have been widely used for decades, and a couple of new techniques to measure magnitude are in the development stage.

All magnitude scales have been designed to give numerically similar results. This goal has been achieved well for M_L, M_s, and M_w.[8][9] The m_b scale gives somewhat different values than the other scales. The reason for so many different ways to measure the same thing is that at different distances, for different hypocentral depths, and for different earthquake sizes, the amplitudes of different types of elastic waves must be measured.

M_L is the scale used for the majority of earthquakes reported (tens of thousands) by local and regional seismological observatories. For large earthquakes worldwide, the moment magnitude scale is most common, although M_s is also reported frequently.

The seismic moment, M_o, is proportional to the area of the rupture times the average slip that took place in the earthquake, thus it measures the physical size of the event. M_w is derived from it empirically as a quantity without units, just a number designed to conform to the M_s scale.[10] A spectral analysis is required to obtain M_o, whereas the other magnitudes are derived from a simple measurement of the amplitude of a specifically defined wave.

All scales, except M_w, saturate for large earthquakes, meaning they are based on the amplitudes of waves which have a wavelength shorter than the rupture length of the earthquakes. These short waves (high frequency waves) are too short a yardstick to measure the extent of the event. The resulting effective upper limit of measurement for M_L is about 7[5] and about 8.5[5] for M_s.[11]

New techniques to avoid the saturation problem and to measure magnitudes rapidly for very large earthquakes are being developed. One of these is based on the long period P-wave,[12] the other is based on a recently discovered channel wave.[13]

The energy release of an earthquake,[14] which closely correlates to its destructive power, scales with the $^3\!/_2$ power of the shaking amplitude. Thus, a difference in magnitude of 1.0 is equivalent to a factor of 31.6 ($= (10^{1.0})^{(3/2)}$) in the energy released; a difference in magnitude of 2.0 is equivalent to a factor of 1000 ($= (10^{2.0})^{(3/2)}$) in the energy released.[15] The elastic energy radiated is best derived from an integration of the radiated spectrum, but one can base an estimate on m_b because most energy is carried by the high frequency waves.

Richter magnitudes

The Richter magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs (adjustments are included to compensate for the variation in the distance between the various seismographs and the epicenter of the earthquake). The original formula is:[16]

$$M_\mathrm{L} = \log_{10} A - \log_{10} A_\mathrm{0}(\delta) = \log_{10}[A/A_\mathrm{0}(\delta)],$$

where A is the maximum excursion of the Wood-Anderson seismograph, the empirical function A_0 depends only on the epicentral distance of the station, δ. In practice, readings from all observing stations are averaged after adjustment with station-specific corrections to obtain the M_L value.

Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; in terms of energy, each whole number increase corresponds to an increase of about 31.6 times the amount of energy released, and each increase of 0.2 corresponds to a doubling of the energy released.

Events with magnitudes greater than 4.5 are strong enough to be recorded by a seismograph anywhere in the world, so long as its sensors are not located in the earthquake's shadow.

The following describes the typical effects of earthquakes of various magnitudes near the epicenter. The values are typical only and should be taken with extreme caution, since intensity and thus ground effects depend not only on the magnitude, but also on the distance to the epicenter, the depth of the earthquake's focus beneath the epicenter, the location of the epicenter and geological conditions (certain terrains can amplify seismic signals).

Magnitude	Description	Mercalli intensity	Average earthquake effects	Average frequency of occurrence (estimated)
Less than 2.0	Micro	I	Microearthquakes, not felt, or felt rarely by sensitive people. Recorded by seismographs.[17]	Continual/several million per year
2.0–2.9	Minor	I to II	Felt slightly by some people. No damage to buildings.	Over one million per year
3.0–3.9		II to IV	Often felt by people, but very rarely causes damage. Shaking of indoor objects can be noticeable.	Over 100,000 per year
4.0–4.9	Light	IV to VI	Noticeable shaking of indoor objects and rattling noises. Felt by most people in the affected area. Slightly felt outside. Generally causes none to minimal damage. Moderate to significant damage very unlikely. Some objects may fall off shelves or be knocked over.	10,000 to 15,000 per year
5.0–5.9	Moderate	VI to VIII	Can cause damage of varying severity to poorly constructed buildings. At most, none to slight damage to all other buildings. Felt by everyone.	1,000 to 1,500 per year
6.0–6.9	Strong	VII to X	Damage to a moderate number of well-built structures in populated areas. Earthquake-resistant structures survive with slight to moderate damage. Poorly designed structures receive moderate to severe damage. Felt in wider areas; up to hundreds of miles/kilometers from the epicenter. Strong to violent shaking in epicentral area.	100 to 150 per year
7.0–7.9	Major	VIII or greater[18]	Causes damage to most buildings, some to partially or completely collapse or receive severe damage. Well-designed structures are likely to receive damage. Felt across great distances with major damage mostly limited to 250 km from epicenter.	10 to 20 per year
8.0–8.9	Great		Major damage to buildings, structures likely to be destroyed. Will cause moderate to heavy damage to sturdy or earthquake-resistant buildings. Damaging in large areas. Felt in extremely large regions.	One per year
9.0 and greater			Near or at total destruction - severe damage or collapse to all buildings. Heavy damage and shaking extends to distant locations. Permanent changes in ground topography.	One per 10 to 50 years

(*Based on U.S. Geological Survey documents*.)[19]

The intensity and death toll depend on several factors (earthquake depth, epicenter location, population density, to name a few) and can vary widely.

Minor earthquakes occur every day and hour. On the other hand, great earthquakes occur once a year, on average. The largest recorded earthquake was the Great Chilean Earthquake of May 22, 1960, which had a magnitude of 9.5 on the moment magnitude scale.[20] The larger the magnitude, the less frequent the earthquake happens.

Examples

The following table lists the approximate energy equivalents in terms of TNT explosive force – though note that the earthquake energy is released *underground* rather than overground.[21] Most energy from an earthquake is not transmitted to and through the surface; instead, it dissipates into the crust and other subsurface structures. In contrast, a small atomic bomb blast (see nuclear weapon yield) will not, it will simply cause light shaking of indoor items, since its energy is released above ground.

Approximate Magnitude	Approximate TNT for Seismic Energy Yield	Joule equivalent	Example
–0.2	7.5 g	31.5 kJ	Energy released by lighting 30 typical matches
0.0	15 g	63 kJ	
0.2	30 g	130 kJ	Large hand grenade
0.5			
1.0	480 g	2.0 MJ	
1.2	1.1 kg	4.9 MJ	Single stick of dynamite [DynoMax Pro]
1.4	2.2 kg	9.8 MJ	Seismic impact of typical small construction blast
1.5	2.7 kg	11 MJ	
2.0	15 kg	63 MJ	
2.1	21 kg	89 MJ	West fertilizer plant explosion[22]
2.5	85 kg	360 MJ	
3.0	480 kg	2.0 GJ	Oklahoma City bombing, 1995
3.5	2.7 metric tons	11 GJ	PEPCON fuel plant explosion, Henderson, Nevada, 1988 Irving, Texas earthquake, September 30, 2012
3.87	9.5 metric tons	40 GJ	Explosion at Chernobyl nuclear power plant, 1986
3.91	11 metric tons	46 GJ	Massive Ordnance Air Blast bomb St. Patrick's Day earthquake, Auckland, New Zealand, 2013 [23][24]
4.0	15 metric tons	63 GJ	Johannesburg/South Africa, November 18, 2013
	43 metric		Kent Earthquake (Britain), 2007

4.3	tons	180 GJ	Eastern Kentucky earthquake, November 2012
5.0	480 metric tons	2.0 TJ	Lincolnshire earthquake (UK), 2008 M_w Ontario-Quebec earthquake (Canada), 2010[25][26]
5.5	2.7 kilotons	11 TJ	Little Skull Mtn. earthquake (Nevada, USA), 1992 M_w Alum Rock earthquake (California), 2007 M_w Chino Hills earthquake (Southern California), 2008
5.6	3.8 kilotons	16 TJ	Newcastle, Australia, 1989 Oklahoma, 2011 Pernik, Bulgaria, 2012
6.0	15 kilotons	63 TJ	Double Spring Flat earthquake (Nevada, USA), 1994 Approximate yield of the Little Boy Atomic Bomb dropped on Hiroshima (~16 kt)
6.3	43 kilotons	180 TJ	M_w Rhodes earthquake (Greece), 2008 Jericho earthquake (British Palestine), 1927 Christchurch earthquake (New Zealand), 2011
6.4	60 kilotons	250 TJ	Kaohsiung earthquake (Taiwan), 2010 Vancouver earthquake (Canada), 2011
6.5	85 kilotons	360 TJ	M_s Caracas earthquake (Venezuela), 1967 Irpinia earthquake (Italy), 1980 M_w Eureka earthquake (California, USA), 2010 Zumpango del Rio earthquake (Guerrero, Mexico), 2011[27]
6.6	120 kilotons	500 TJ	M_w San Fernando earthquake (California, USA), 1971
6.7	170 kilotons	710 TJ	M_w Northridge earthquake (California, USA), 1994
6.8	240 kilotons	1.0 PJ	M_w Nisqually earthquake (Anderson Island, WA, USA), 2001 M_w Great Hanshin earthquake (Kobe, Japan), 1995 Gisborne earthquake (Gisborne, NZ), 2007
6.9	340 kilotons	1.4 PJ	M_w San Francisco Bay Area earthquake (California, USA), 1989

			M_w Pichilemu earthquake (Chile), 2010 M_w Sikkim earthquake (Nepal-India Border), 2011
7.0	480 kilotons	2.0 PJ	M_w Java earthquake (Indonesia), 2009 M_w Haiti earthquake, 2010
7.1	680 kilotons	2.8 PJ	M_w Messina earthquake (Italy), 1908 M_w San Juan earthquake (Argentina), 1944 M_w Canterbury earthquake (New Zealand), 2010
7.2	950 kilotons	4.0 PJ	Vrancea earthquake (Romania), 1977 M_w Azores Islands Earthquake (Portugal), 1980 M_w Baja California earthquake (Mexico), 2010
7.5	2.7 megatons	11 PJ	M_w Kashmir earthquake (Pakistan), 2005 M_w Antofagasta earthquake (Chile), 2007
7.6	3.8 megatons	16 PJ	M_w Nicoya earthquake (Costa Rica), 2012 M_w Oaxaca earthquake (Mexico), 2012 M_w Gujarat earthquake (India), 2001 M_w İzmit earthquake (Turkey), 1999 M_w Jiji earthquake (Taiwan), 1999
7.7	5.4 megatons	22 PJ	M_w Sumatra earthquake (Indonesia), 2010 M_w Haida Gwaii earthquake (Canada), 2012
7.8	7.6 megatons	32 PJ	M_w Tangshan earthquake (China), 1976 M_s Hawke's Bay earthquake (New Zealand), 1931 M_s Luzon earthquake (Philippines), 1990 M_w Gorkha earthquake (Nepal), 2015[28]
7.9	10.7 megatons	45 PJ	Tunguska event M_w 1802 Vrancea earthquake M_w Great Kanto earthquake (Japan), 1923
			M_s Mino-Owari earthquake (Japan), 1891

8.0	15 megatons	63 PJ	San Juan earthquake (Argentina), 1894 San Francisco earthquake (California, USA), 1906 M_s Queen Charlotte Islands earthquake (B.C., Canada), 1949 M_w Chincha Alta earthquake (Peru), 2007 M_s Sichuan earthquake (China), 2008 Kangra earthquake, 1905
8.1	21 megatons	89 PJ	México City earthquake (Mexico), 1985 Guam earthquake, August 8, 1993[29]
8.35	50 megatons	210 PJ	Tsar Bomba—Largest thermonuclear weapon ever tested. Most of the energy was dissipated in the atmosphere. The seismic shock was estimated at 5.0–5.2[30]
8.5	85 megatons	360 PJ	M_w Sumatra earthquake (Indonesia), 2007
8.6	120 megatons	500 PJ	M_w Sumatra earthquake (Indonesia), 2012
8.7	170 megatons	710 PJ	M_w Sumatra earthquake (Indonesia), 2005
8.75	200 megatons	840 PJ	Krakatoa 1883
8.8	240 megatons	1.0 EJ	M_w Chile earthquake, 2010
9.0	480 megatons	2.0 EJ	M_w Lisbon earthquake (Portugal), All Saints Day, 1755 M_w The Great East Japan earthquake, March 2011
9.15	800 megatons	3.3 EJ	Toba eruption 75,000 years ago; among the largest known volcanic events.[31]
9.2	950 megatons	4.0 EJ	M_w Anchorage earthquake (Alaska, USA), 1964 M_w Sumatra-Andaman earthquake and tsunami (Indonesia), 2004 M_w Cascadia earthquake (Pacific Northwest, USA), 1700
9.5	2.7 gigatons	11 EJ	M_w Valdivia earthquake (Chile), 1960
13.00	100 teratons	420 ZJ	Yucatán Peninsula impact (creating Chicxulub crater) 65 Ma ago (10^8 megatons; over 4×10^{29} ergs = 400 ZJ).[32][33][34][35][36]
22.88 or 32	310 yottatons	1.3×10^{39} J	Approximate magnitude of the starquake on the magnetar SGR 1806-20, registered on December 27, 2004.

- Quakes using the more modern magnitude scales will denote their abbreviations: M_w and M_s. Those that have no denoted prefix are M_L. Please be advised that the magnitude "number" (example 7.0) displayed for those quakes on this table may represent a significantly greater or lesser release in energy than by the correctly given magnitude (example M_w).

Magnitude empirical formulae

These formulae are an alternative method to calculate Richter magnitude instead of using Richter correlation tables based on Richter standard seismic event (M_L=0, A=0.001mm, D=100 km).

The Lillie empirical formula:

$$M_\mathrm{L} = \log_{10} A - 2.48 + 2.76 \log_{10} \Delta$$

Where:

- A is the amplitude (maximum ground displacement) of the P-wave, in micrometers, measured at 0.8 Hz.
- Δ is the epicentral distance, in km.

For distance less than 200 km:

$$M_\mathrm{L} = \log_{10} A + 1.6 \log_{10} D - 0.15$$

For distance between 200 km and 600 km:

$$M_\mathrm{L} = \log_{10} A + 3.0 \log_{10} D - 3.38$$

where A is seismograph signal amplitude in mm, D distance in km.

The Bisztricsany (1958) empirical formula for epicentral distances between 4° to 160°:

$$M_\mathrm{L} = 2.92 + 2.25 \log_{10}(\tau) - 0.001 \Delta^\circ$$

Where:

- M_L is magnitude (mainly in the range of 5 to 8)
- τ is the duration of the surface wave in seconds
- Δ is the epicentral distance in degrees.

The Tsumura empirical formula:

$$M_\mathrm{L} = -2.53 + 2.85 \log_{10}(F - P) + 0.0014 \Delta^\circ$$

Where:

- M_L is the magnitude (mainly in the range of 3 to 5).
- $F - P$ is the total duration of oscillation in seconds.
- Δ is the epicentral distance in kilometers.

The Tsuboi, University of Tokyo, empirical formula:

$$M_\mathrm{L} = \log_{10} A + 1.73 \log_{10} \Delta - 0.83$$

Where:

- M_L is the magnitude.
- A is the amplitude in um.
- Δ is the epicentral distance in kilometers.

See also

- 1935 in science
- Japan Meteorological Agency seismic intensity scale – does the same thing as the Mercalli Scale, but in

different numbers

- Largest earthquakes by magnitude
- Mercalli intensity scale - Measures the intensity of an earthquake
- Moment magnitude scale
- Order of magnitude
- Rohn Emergency Scale for measuring the magnitude (intensity) of any emergency
- Seismic scale
- Seismite
- Timeline of United States inventions (1890–1945)

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External links

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- USGS: Earthquake Magnitude Policy (http://earthquake.usgs.gov/aboutus/docs/020204mag_policy.php)
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- USGS: 1990–1999 Earthquakes worldwide (http://neic.usgs.gov/neis/eqlists/info_1990s.html)
- Alaska Railroad Earthquake (http://www.alaskarails.org/historical/earthquake/earthquake-richter.html) with a table of yield-to-magnitude relations.
- Earthquake Energy Calculator (http://www.alabamaquake.com/energy.html) with seismic energy approximated in everyday equivalent measures.

Richter

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Richter may refer to:

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- the Richter magnitude scale, scale measuring the strength of earthquakes
- Richter (electro rock), electro-rock band from Buenos Aires, Argentina
- Richter, Kansas
- Richter (surname)

Miscellaneous

- Richter Abend, character from the game *Tales of Symphonia: Dawn of the New World*
- The Richter tuning scale developed in 1825 to which harmonicas are commonly tuned
- Gedeon Richter Ltd., Hungarian pharmaceutical company
- Richter (toy company), German toy manufacturer from the early 20th century
- Richter Belmont, character from the Castlevania game series
- "Goin' Richter," song by The Ziggens
- Richter's transformation or Richter's syndrome, complication of blood-related neoplasms

Categories: Disambiguation pages
